Conservative Constrained Interpolating Polynomials

Oleg Kravchenko* & Manuel Diaz[1]

* Department of Nuclear Physics, University of Examples, Moscow, Russia.
[1] Institute of Applied Mechanics, National Taiwan University, Taiwan R.O.C.

July 28, 2015

Abstract

This a sample LaTeXdocument that explains some of the LaTeXcommands

1 Introduction

LaTeX is a markup language designed and implemented by **Leslie Lamport**, based on **Donald E. Knuth**'s typesetting language TeX. The markup in the source file of a LaTeX document my appear somewhat challenging, but the compiled result of the document is certainly a pleasing rendering of the mark-up material. Yabe and Aoki (1991), Yabe et al. (2001), Ii and Xiao (2007), Nakamura et al. (2001), Ii and Xiao (2009), Xiao and Yabe (2001), Xiao (2004).

LaTeX was built on TeX's foundation. An article is divided into *logical units*, including an abstract, various sections and subsections, theorems, and a bibliography. The logical units are typed independently of one another. Once all the units have been typed, LaTeX controls the *placement* and *formating* of these elements. LaTeX automatically numbers the sections, theorems, and equations in your article, and builds the cross-references. If any changes is made to the article, it automatically renumbers its various parts and rebuilds the cross-references.

Packages are extensions of LaTeX. LaTeX commands, as a rule, start with a backslash (\) and tells LaTeXto do something special. For example, in the instruction
`\emph{instructions to \LaTeX}` , `\emph` is a LaTeX command. Another kind of instruction is called an *environment*. For example, the commands `\begin{flushright}` and `\end{flushright}` enclose a `flushright` environment—texts that are typed inside this environment are right justified (lined up against the right margin) when typeset.

2 Typing Text

The following keys are used to type text in a LaTeX source file:

```
a-z  A-Z  0-9
```

```
+ = * / ( ) [ ]
```

You may also use the following punctuation marks:

```
, ; . ? ! : ‘ ’ -
```

and the spacebar, and the Return (or Enter) key.

There are thirteen special keys that are mostly used in LaTeX instructions:

```
# $ % & ~ _ ^ \ { } @ " |
```

If you need to use them in your document, there are commands available for typesetting these special characters. For example, $ is typed as `\$`, the underscore (_) is typed as `\_`, and % is typed as `\%`, whereas ä is typed as `\"{a}`, and @ is simply typed `@`.

In a LaTeX source file, each *comment* line begins with %. LaTeX will ignore everything on the line after the % character.

The *document class*, declared by the command `\documentclass{..}`, in a LaTeX source file controls how the document will be formatted. LaTeX, by default, fully justifies the text by placing a certain size space between words—the *interword space*—and a somewhat larger space between sentences–the *intersentence space*. To force an interword space, you can use the `\␣` command (the ␣ symbol indicates a blank space). The ˜ (tilde) command also forces an interword space, but with a difference: it keeps words together on the same line. It is called a “tie” or “non-breakable space.”

When LaTeX encounters a period, it must decide whether or not it indicates the end of a sentence. It uses the following rule: A period following a capital letter (e.g., A.) is interpreted as being part of an abbreviation or an initial and will be followed by an interword space; otherwise, it signifies the end of a sentence and will be followed by an intersentence space. If this rule causes problems in your document, you can follow the period with `\␣` to force an interword space, or precede the period with `\@` to force an intersetence space.

In a LaTeX document source file, left double quotes are typed a `‘ ‘` (two left single quotes) and right double quotes are type as `’ ’` (two right single quotes). The left single quote key is usually in the upper-left or upper-right corner of the keyboard, and shares a key with the tilde (`~`) key.

In a LaTeX command that requires an argument, the argument follows the name of the command and is placed between { and }. Command names are *case sensitive*. The command `\\` (`\newline` is another form) breaks a line. You can use the `\\` command and specify an appropriate amount of vertical space, for example `\\[1in]`. Note that this command uses *square brackets* rather than braces because the argument is *optional.* The distance/spacing may be given in points(pt), centimenters(cm), or inches(in). To force a page break, use `\newpage`.

3 Typing Math

In addition to the keys listed above, you need the keys `|,` `<`, and `>` to type mathematical formulas. (`|` is the shifted `\` key on many keyboards).

There are two kinds of math formulas and environments:

1. *Inline math environments* open and close with $ or open with `\(` and close with `\)`.
2. *Displayed math environments* open with `\[` and close with `\]`. Other forms of the displayed environment are `\begin{equation*} ... \end{equation*}` and `\begin{equation} ... \end{equation}`.

Within the math environment, LaTeXuses its own spacing rules and completely ignores the number of white spaces typed with two exceptions:

1. Spaces that delimit commands (e.g., in `$\infty a$`, the space is not ignored; in fact, `\inftya$` is an error)
2. Spaces in the arguments of commands that temporarily revert to text mode (`\mbox` and `\text` are such commands).

In text mode, many spaces equal one space; whereas, in math mode, spaces are ignored (unless they terminate a command). To asjust the spacing in a typeset document, use a spacing command. The same formula may be typeset differently depending on whether it is inline or display. For example, $\sum_{i=1}^{n} i^2$ is inline math. The following is the same expression as displayed math

$$\sum_{i=1}^{n} i^2.$$

Math symbols are invoked by commands inside a math formula or environment. The math symbols are organized into tables in Appendix A of textbook. Some commands (e.g. `\sqrt`) need arguments enclosed in braces ({ and }). For example, to typeset $\sqrt{x^2 y^2}$, type `$\sqrt{x^{2} y^{2}}$`. To typeset $\sqrt[n]{x^2 y^2}$, type `$\sqrt[n]{x^{2} y^{2}}$`. Some commends need more than one arguments. For example to typeset

$$\frac{\sin x}{\cos^2 x + \tan x}$$

type

```
\[
   \frac{\sin x}{\cos^{2} x + \tan x}
\]
```

`\frac` is the command; $\sin x$ and $\cos^2 x + \tan x$ are the arguments.

Theorem 1. *This is the Pythagorean Theorem. It says*

$$x^2 + y^2 = z^2. \tag{1}$$

Definition 1. *Earth is where life is possible.*

4 Concluding Remarks

References

Ii, S. and F. Xiao

2007. Cip/multi-moment finite volume method for euler equations: a semi-lagrangian characteristic formulation. *Journal of Computational Physics*, 222(2):849–871.

Ii, S. and F. Xiao

2009. High order multi-moment constrained finite volume method. part i: Basic formulation. *Journal of Computational Physics*, 228(10):3669–3707.

Nakamura, T., R. Tanaka, T. Yabe, and K. Takizawa

2001. Exactly conservative semi-lagrangian scheme for multi-dimensional hyperbolic equations with directional splitting technique. *Journal of Computational Physics*, 174(1):171–207.

Xiao, F.

2004. Unified formulation for compressible and incompressible flows by using multi-integrated moments i: one-dimensional inviscid compressible flow. *Journal of Computational Physics*, 195(2):629–654.

Xiao, F. and T. Yabe

2001. Completely conservative and oscillationless semi-lagrangian schemes for advection transportation. *Journal of computational physics*, 170(2):498–522.

Yabe, T. and T. Aoki

1991. A universal solver for hyperbolic equations by cubic-polynomial interpolation i. one-dimensional solver. *Computer Physics Communications*, 66(2):219–232.

Yabe, T., R. Tanaka, T. Nakamura, and F. Xiao

2001. An exactly conservative semi-lagrangian scheme (cip-csl) in one dimension. *Monthly Weather Review*, 129(2):332–344.